"Where there is no vision, the people perish...."

—Proverbs 29:18

Editorial

Sustainable Environment for All

There is growing evidence that the somewhat apocalyptic nature of the commentary on page 1164 is being considered most seriously by the present administration in the United States and by most of the other nations in the world. John Cairns, the titular spokesperson for ecology in *Environmental Health Perspectives* since the inception of the monthly journal in April 1993, delivers a tough message to the public in "Defining Goals for Ecosystem Measurements," suggesting that unless we make fundamental changes in behavior and lifestyle, the possibility exists that we will be unable to reverse the trend of decline in environmental quality and life. He suggests a variety of different conditons that would have to be considered and altered in order to accomplish the changes. Indeed, recently published papers (*1,2*) and books (*3–6*) reach similar conclusions after developing quantitative estimates of the world's ecosystem services. The authors pose what may be some of the most important questions for the millineum, namely, what and how do ecosystems affect humans, and are humans in danger of altering ecosystems to the extent that recovery is impossible?

One is initially inclined to dismiss articles that project a doomsday unless this or that is performed, and some will believe this commentary deserves such a fate. However, there may be more here than we ever want to contemplate; popular and scientific reports are occurring with increasing frequency that detail the demise of primary ecosystems and that are unable to predict what the outcome will be on our centrist universe. A group of ecologists and economists published a recent paper in *Nature* that provides a startling estimate of what it would cost if one had to replace the services provided by vital ecosystems for earth (*2*). The value of ecosystem services, defined as 17 life-support systems on earth, broken down into 16 biomes, was conservatively estimated to be worth between US $16-54 trillion per year, compared to the global gross national product of around US $18 trillion per year. These estimates do not take into account the cost for a minimum level of infrastructure for ecosystems to allow the production of a broad range of services. For example, the single forest biome occupies an area of 4,855 million hectares on the earth and supplies ecosystem services for climate regulation, disturbance regulation, water regulation, water supply, erosion control, soil formation, nutrient cycling, waste treatment, biological control, food production, raw materials, genetic resources, recreation, and cultural purposes. The value of this service adds up to a value of $969 per hectare per year for a total global flow value of $4,704 billion per year.

Arguably, there is no scientific agreement whether such changes in diverse parameters like climate, biodiversity, carbon cycles, global warming, ocean salinity, ozone layer, air pollution, greenhouse gases, fisheries populations, or sea levels are significant enough to measurably alter earth's ecosystems and affect the lifestyle of generations to come. Yet the frequency of articles on this venue are increasing rapidly; virtually every issue of *Science* and *Nature* contain reports on perturbations of vital ecosystems. Nations of the world are meeting with increasing frequency to determine the nature of the problems and what can be done to stop, slow, or reverse the changes that are occurring in global ecosystems. A coalition of scientists, economists, politicians, and sociologists is emerging and all of these groups reach the same conclusion—that there is a problem with ecosystems on a worldwide basis—but they cannot yet agree on what a viable solution could be, as might be imagined from the vast differences in each of their perspectives.

Recent technological advances, such as the global information system that uses global positioning satellites to pinpoint locations anywhere in the world, infrared analysis to map biomes, the internet for rapid communication, and parallel computational power to examine masses of data, exemplify the ability of science to operate on a global basis. For the first time baselines can be established and changes that occur in specific ecosystems can be quantified.

Nations are recognizing the value of ecosystems and are making progress in programs that complement sustainable development. Since the Earth Summit in Rio de Janeiro in 1992, there has been some worldwide progress: banning of leaded gasoline, proposals to slow the cutting and burning of forests, and some commitments to increase government assistance for sustainable development in developing countries. A special session of the United Nations General Assembly met to formally review progress since that event (*7*). This year marks the tenth anniversary of agreements to reduce emissions of ozone-depleting substances into the stratosphere, known as the Montreal Protocol on Substances that Deplete the Ozone Layer (*8*). Amendments are being considered to urge countries like Mexico and Russia, that have not yet phased out chlorofluorocarbons, to stop production before officially imposed deadlines. Another meeting of nations in Kyoto, Japan, in December 1997 will focus on greenhouse gas emissions to discuss potential economic and political solutions agreeable to both developed and developing nations (*9*).

In the United States a nationwide GAP analysis program is under way to identify state by state where there are species and habitats found on unprotected lands or "gaps" in the network of conservation landholdings (*10*). Identification of these "gaps" can permit set aside zones for purchase or development into areas for species enrichment, and the data can be used to model how future environmental changes might impact biological diversity.

There are global changes being reported that suggest disturbances of numerous individual ecosystems, and even if they cannot be completely understood or connected with one another, there is a high probability that the portended changes are now occurring or will occur. Must action be taken before it is too late—before the events are completely proven and understood? Could the failure of one ecosystem result in a cascade of responses? The solution to a global problem of this magnitude deserves the attention of the finest scholars in the world. That 1,500 prominent scientists, including a majority of living Nobel Laureate members, agreed in 1992 and again in 1997, that the problem of worldwide ecosystem destruction is the most important deliberation extant, lends credence to the questions.

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References

1. Pimm SL. The value of everything. Nature 387:231–232 (1997).
2. Costanza R, d'Arge R, de Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neill RV, Paurelo J. The value of the world's ecosystem services and natural capital. Nature 387:253–260 (1997).
3. Daily GC. Nature's Services: Societal Dependence on Natural Ecosystems. Washington, DC:Island Press, 1997.
4. Baskin Y. The Work of Nature: How the Diversity of Life Sustains Us. Washington, DC:Island Press, 1997.
5. von Weizsacker E, Lovins AB, Lovins LH. Factor Four: Doubling Wealth, Halving Resource Use. London:Earthscan, 1997.
6. Berger JJ. Charging Ahead: The Business of Renewable Energy and What It Means for America. New York:Henry Holt & Co., 1997.
7. Hileman B. Earth Summit: Talk Not Action. C&E News July 14:29–32 (1997).
8. Hileman B. Ozone treaty: successful, but pitfalls remain. C&E News September 15:24 (1997).
9. Hileman B. New approach for greenhouse talks. C&E News September 22:22–26 (1997).
10. Korbley KP. Application series: land cover mapping. National GIS fills "GAPS" in biological diversity. GIS WORLD 96:50–53 (1966).